

CHAPTER 4

PAVEMENT MANAGEMENT PROCESS

4.1 ROLE OF THE PMS SOFTWARE AND PAVEMENT MANAGER

The Pavement Manager will ensure the PMS software is properly maintained and that pavement condition data will be collected on a regular basis. Construction history data must be updated as projects are completed. Utility holds and other stops must be entered into the system. Other data, such as bike lanes, bus routes, and any other data affecting paving schedule decisions must be updated in the PMS.

Once the required data has been gathered, the PMS software develops an M&R plan based on pavement condition, M&R policy, and available budget. Cartêgraph Pavementview Plus PMS software uses a two-step treatment selection process. The first step is to determine all technically appropriate M&R treatments available to maintain or improve a segment. Some segments may have multiple technically appropriate treatments. Cartêgraph Pavementview Plus uses a treatment selection matrix for this process. The next step is to determine which segments (and in the case of multiple possible treatments for a segment, which treatments) are actually recommended for treatment based on the network priority rating calculations. These segments and their associated recommended treatments make up the work plan. Figure 4.1 is a schematic showing the process used by the software to develop a work plan. The plan estimates both the type of work required on each segment, and the amount of money required to do it. The list of projects generated typically covers multiple years and is prioritized by segment to provide the maximum benefit to the pavement network.

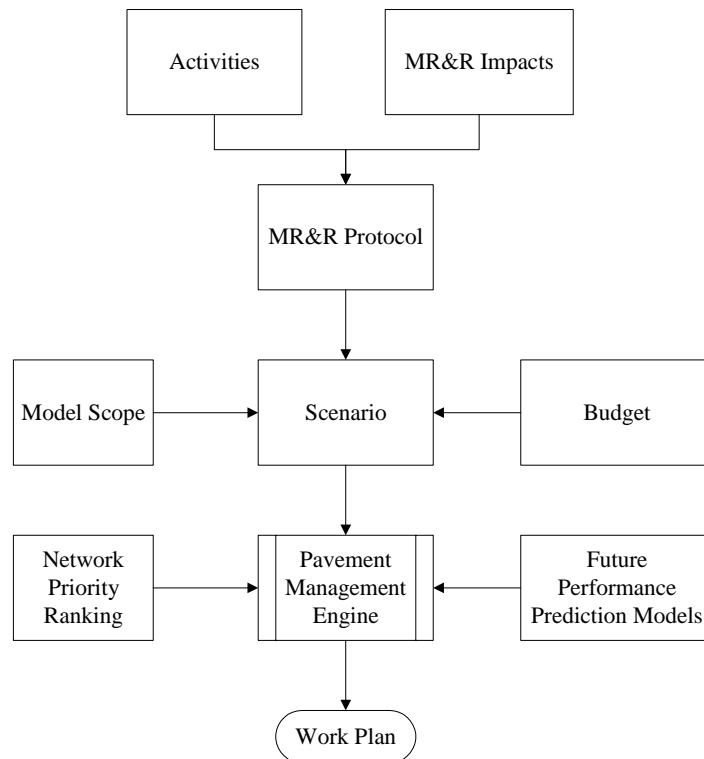


Figure 4.1. Flow chart illustrating PMS process.

The Pavement Manager then takes the M&R work plan recommendations from the PMS software and determines the best way to implement them. This typically involves combining adjacent segments into projects for bidding. Oftentimes M&R on a segment will be promoted from an out-year project to a current year project based on factors too complex for the PMS, such as an adjacent construction project or contingency funding. Paving projects are subject to the limitation that the area-weighted average condition of all segments in a project should be less than 70. While the paving manager has discretion in when and how to apply the software recommendations, the software ensures that a street or neighborhood is not "forgotten."

4.2 ROLE OF THE OCI

OCI is the primary factor in treatment selection for MPW. Pavements with an OCI below 70 are flagged as candidates for an overlay or reconstruction. Pavements with a condition above 70 are flagged as candidates for crack sealing, surface treatment, or thin overlay depending on age and functional classification. Photos 4.1 through 4.8 show typical OCI 70 pavements.



Photo 4.1. 8th Avenue North, segment 10213, block cracking, patching, and linear cracking.



Photo 4.2. Joseph Avenue, segment 8421, patching, linear cracking, rutting, and roughness.



Photo 4.3. Massman Drive, segment 16332, fatigue cracking, roughness, and potholes.



Photo 4.4. 18th Avenue South, segment 17436, patching, linear cracking, and roughness.



Photo 4.5. McGavock Pike, segment 21438, fatigue cracking, linear cracking, rutting, and roughness.



Photo 4.6. Somerset Drive, segment 23871, rutting, roughness, and fatigue cracking.



Photo 4.7. Benzing Road, segment 27313, block cracking and linear cracking.



Photo 4.8. Sidco Road, segment 30397, patching.

4.3 TREATMENT SELECTION MATRIX

Table 4.1 shows the treatment selection matrix implemented by MPW. The treatment selection matrix is based on the guidelines used by the MPW paving office when selecting paving projects. The rules are summarized as follows:

- Pavements must have an OCI<70 to be a candidate for repaving.
- Pavements must have a curb to be recommended for milling prior to an overlay.
- Pavements must have an OCI<40 and structural distresses, or have an OCI<70 and high severity structural distresses to be a candidate for reconstruction.
- The grade of AC used in an overlay is based on the functional class of the segment as follows:
 - RCW: Local streets
 - E-Mix: Collectors
 - D-Mix: Arterial
 - Polymer: Industrial
- Pavements must have an OCI≥70 and be less than 10 years old to be eligible for crack sealing. Only residential and collector streets are eligible for crack sealing.

- Pavements must have an $OCI \geq 70$ and be less than 7 years old to be eligible for surface seals (chip seals, slurry seals). Surface treatments are not recommended for arterial pavements.
- Pavements must have an $OCI \geq 70$ and be less than 5 years old to be eligible for surface treatments (penetrants and sealants). Only residential streets are eligible for surface treatments.
- Pavements must have an $OCI \geq 70$ and be between 7 and 10 years old to be recommended for thin overlays. Thin overlays are not recommended for arterial pavements.

Table 4.1. Treatment selection matrix.

Treatment	Condition	Age (years)	Functional Class	Distresses	Other
Crack Seal	$OCI \geq \text{critical}$	≤ 10	Residential Collector	L&T Block Edge Joint Reflection	N/A
Surface Treatment (Penetrants and rejuvenators)	$OCI \geq \text{critical}$	≤ 5	Residential	N/A	N/A
Surface Seals (chip seals and slurry seals)	$OCI \geq \text{critical}$	≤ 7	Residential Collector Commercial	N/A	N/A
Thin Overlay (HMAC and proprietary)	$OCI \geq \text{critical}$	≤ 10	Residential Collector Commercial	N/A	N/A
RCW Overlay (recycled mix)	$OCI < \text{critical}$	N/A	Residential	N/A	No curb
Mill/RCW Overlay	$OCI < \text{critical}$	N/A	Residential	N/A	N/A
E-mix Overlay	$OCI < \text{critical}$	N/A	Collector Commercial	N/A	No curb
Mill/E-mix Overlay	$OCI < \text{critical}$	N/A	Collector Commercial	N/A	N/A
D-mix Overlay	$OCI < \text{critical}$	N/A	Arterial	N/A	No curb
Mill/D-mix Overlay	$OCI < \text{critical}$	N/A	Arterial	N/A	N/A
Polymer Overlay	$OCI < \text{critical}$	N/A	Industrial	N/A	No curb
Mill/Polymer Overlay	$OCI < \text{critical}$	N/A	Industrial	N/A	N/A
Reconstruction	$OCI < 40$	N/A	N/A	Alligator Rutting Corrugation High Bleeding	N/A
Reconstruction	$40 \leq OCI < \text{critical}$	N/A	N/A	High Alligator High Rutting High Corrugation High Bleeding	N/A

4.4 NETWORK PRIORITIZATION RATING CALCULATION

After Cartêgraph Pavementview Plus has developed a list of technically applicable treatments, the segments and associated treatments are prioritized according to the NPR calculation. The NPR is a numerical index ranging from 0 for a low priority road segment to 100 for a high priority road segment. The NPR rating is computed by assigning weights, or importance factors, to various street parameters. MPW prioritizes segments according to functional class, OCI, and the paving hold list. The paving hold list can be used to delay a project or move the project timetable forward. Table 4.2 shows NPR component values for the three factors used by MPW.

Table 4.2. NPR component values.

Factor	Weighting Factor	Factor Value	NPR Value
OCI	25	Any	OCI
Functional Class	25	Arterial	100
		Collector	50
		Local/Other	25
Capital Project List (Hold List)	50	Delay	0
		None	50
		Move Up	100

Using an arterial segment with an OCI of 65 and no paving holds, the NPR for the segment is calculated as follows:

$$NPR = \frac{25 * OCI + 25 * FC + 50 * Hold}{100} = \frac{25 * 65 + 25 * 100 + 50 * 50}{100} = 66.25$$

A residential street with an OCI of 40 and paving hold would end up with an NPR of 16.25. In this case, the arterial would be worked on first even though its OCI is much higher.

This NPR selection method avoids a "worst-first" M&R plan. Worst-first plans focus on the very worst pavements, spending money on costly fixes for a few pavements while the remaining pavements are neglected, eventually requiring costly repairs. Under the method used in the Cartêgraph Pavementview Plus system, precedence is given to preventive M&R first. Pavements that are below the critical OCI but have not completely failed are recommended next, with completely failed pavements rehabilitated last. This results in money being spent to rehabilitate pavements before rehabilitation becomes prohibitively expensive. While the repairs of the very worst pavements are delayed, the delay does not significantly affect the cost of repairs.

This prioritization method results in more efficient use of resources by allocating money where it has the most impact and considering pavement deterioration in segments not immediately repaired. This method also considers that fact that pavements in better condition are often less costly to repair. Table 4.3 demonstrates the concept, assuming that pavements deteriorate at five OCI points per year.

Table 4.3. Cost savings using NPR method.

Street	Current OCI	Repair Year	OCI When Repaired	Repair Cost
Network Priority Rating Method				
1	60	1	60.0	\$2.04/ft ²
2	30	2	25.0	\$4.69/ft ²
Total Repair Cost				\$3.37/ft²
Repair Worst First				
1	60	2	55.0	\$2.48/ft ²
2	30	1	30.0	\$4.69/ft ²
Total Repair Cost				\$3.58/ft²

4.5 WORK PLAN GENERATION

Work plans are generated by listing segments in NPR order (from 100 to 0) and applying treatments until the budget for that plan year reaches zero. When the budget reaches 0, the software repeats the entire process for the next plan year.

The software does not stop generating projects at the first segment that cannot be rehabilitated because of lack of funding. For example, the unit cost to overlay a segment might be \$3.75/ft², the NPR is 75, and it has an area of 20,000 ft². At the point where this segment is considered for an overlay, there may be \$70,000 left to spend from the budget. Since the cost of the overlay is \$75,000, it is not programmed for this year. However, the next segment in the list might have an area of 10,000 ft² and an NPR of 74.6. While the first segment is not programmed, the second, smaller segment is programmed with a cost of \$37,500. The program would continue going down the list looking for other segments that can be rehabilitated for less than \$32,500 (what remains in the budget).

There are some other factors involved in the work plan generation. First, it is possible to have more than one budget. As in the example above, the program will keep trying to determine if there is money available to perform feasible treatments even after it finds segments that do not qualify because of budget limits. For example, Paving may run out of money in its “MPW Only” budget (where road rehabilitation is fully funded by MPW) but there still might be money in the “State-Aid” budget. In this case, Cartêgraph Pavementview Plus will continue looking for segments that are on State Aid routes that require rehabilitation. It is possible to end a year with surplus funds in the budget. This means that all the feasible rehabilitations have been performed for that year based on the decision matrix.

At this point, the software has generated its best estimate of M&R requirements and how to address them. The Pavement Manager takes this list and uses engineering judgment to develop the final M&R list. When developing paving group project limits, projects are subject to the condition that the area-weighted average OCI of all segments in a paving project should be less than 70. Surface treatment, crack sealing, and thin overlay projects are not subject to this limitation. The three most common adjustments to the M&R list are:

- Combining projects
- Delaying projects
- Advancing projects

The most common of these is to combine projects. For example, the software may recommend repaving Church Street from 1st to 2nd, 2nd to 3rd, and 3rd to 4th. When the paving list is published, it would simply state "Church Street from 1st to 4th."

Projects are typically delayed to accommodate some sort of construction that would affect the condition of the street. Typically, this is some sort of planned utility work, such as replacing storm sewers along a road. It could be a construction project that would result in a temporary increase of heavy truck traffic along a route; in this case it would be better to delay repaving until after the construction project so that the old pavement is damaged, not the newly repaved surface.

Project schedules are typically moved forward due to proximity to other projects. For example, Cartêgraph Pavementview Plus may recommend repaving Church Street from 1st to 4th and 6th to 10th in year 1 of the plan, and from 4th to 6th in year 3 of the plan. To minimize mobilization costs and traffic disruption, the Pavement Manager may decide to pave the entire street from 1st to 10th in year 1 of the plan.

4.6 SCOPE

It is possible to eliminate certain segments from any consideration in the work plan through model scopes. A model scope is a filter that specifies which segments should be eligible for the work plan. They are setup in the Model Scopes screen in Cartêgraph Pavementview Plus. For example, MPW may want to consider a plan that does not include the State Aid roads. By defining a model scope that excludes State Aid roads, the segments that are defined as State Aid are removed from the NPR list.

4.7 GIS MAPPING OF PAVING PROJECTS

The PMS data is linked to MPW's enterprise GIS. This link allows any of the data maintained in the PMS to be displayed as an attribute in the GIS. For instance, all pavement segments with OCI of 70 or higher can be displayed graphically in the GIS as green segments on a map, while segments with an OCI less than 70 can be displayed in red. Subsequently, as paving projects are identified, the scope of these projects will include specific pavement segments that correlate to records in the PMS. These segments can be highlighted on a map generated by the GIS. The data may also be viewed, printed or published to the web as an Internet map service or static map.